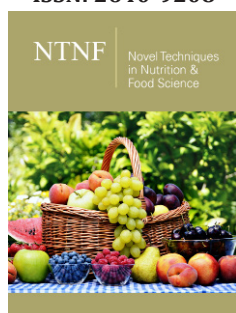


# Prospective Study: Sea Cucumber Flour as a Food Supplement

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## Abstract

Sea cucumbers (*holoturia*) are considered a dietary delicacy, being widely used in medicinal healing by Asians over the centuries; they are rich in bioactive compounds with the potential to exert several actions in the body, namely: Anticancer, anticoagulant, antihypertensive, anti-inflammatory, antimicrobial, antioxidant, antithrombotic and antitumor. The sea cucumber drying process, as used for the flour production, maintains their functional properties. Thus, in view of the benefits associated with the consumption of sea cucumber to human health, evidenced by scientific research, a market diagnosis was carried out for its flour as a food supplement. This study aimed to carry out market research to assess the interest of Brazilians in the consumption of sea cucumber flour. Market prospecting research for sea cucumber flour was carried out using the survey monkey tool. The structured questionnaire consisted of ten closed questions, which were answered by 100 people. The public interviewed was heterogeneous: 36% between 15 and 25 years old; 11% between 26 and 35 years old; 12% between 36 and 45 years old, 18% between 46 and 55 years old and 23% of the public over 55 years old. About 97% claimed to have never consumed sea cucumbers or derivatives, but 91% expressed interest in consuming sea cucumber-based flour, given its nutraceutical potential. Among the levels of interest: 33% reasonable, 46% interested and 13% very interested; and 67% indicated the preferential acquisition in capsule form. Regarding the cost for 100g of the product: 64% would pay up to 3.89 dollars, 33% between 4.08 and 5.83 dollars and only 3% would pay more than 5.83 dollars. As for the frequency of consumption: 53% would consume daily. Conclusion: The research indicated market potential for sea cucumber flour, especially in capsules, as a food supplement. However, most of these animals come from extractive fisheries. Thus, it is a challenging task to reconcile the conservation need with the socioeconomic importance of fisheries. In this sense, to encourage the production of these organisms through aquaculture and the sea cucumber flour production with added value, will meet the prospects of the current market that seeks greater healthiness through nutrition and/or supplementation and foods with a lower carbon emission.

**Keywords:** Seafood; Nutraceuticals; Added value; Conscious consumption; Sustainability

## Introduction

Sea cucumbers (holoturias) are considered a dietary delicacy being widely used in medicinal healing by Asians over the centuries [1]. Its main markets are Hong Kong, Singapore and Taiwan [2]. According to Hu [3], in the late 1980s, sea cucumber fisheries grew rapidly and expanded due to the international market for béche-de-mer (dry and salted product). Despite the potential for export in the dried form, they can be marketed frozen, cooked and dried, cooked and salted, and even cooked dry and salted [4,5]. According to Purcell et al. [5], high quality sea cucumbers can cost US\$ 2,000.00 in specialized stores. Sea cucumbers play an important role in human nutrition, given their valuable nutritional profile, such as vitamin A, vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin) and minerals, especially calcium, magnesium, iron and zinc [6]. In addition, it is a protein and low-fat marine food [7]. They are also a source of essential amino acids, including threonine, valine, methionine, tryptophan, phenylalanine, isoleucine, leucine and lysine, in significantly greater amounts than in fish. The most abundant amino acids in different sea cucumber species are glycine, glutamic acid, aspartic acid, alanine and arginine [8]. However, the compositions of these fresh echinoderms vary according to the species, season, habitat and, probably, the scope of ontogeny [9].

Observing the food and cultural behavior of Asian countries, such as China, the pharmaceutical industry and research have carried out studies with interest, especially in the isolation of bioactive molecules from sea cucumbers, with hemolytic activities [10,11] anti-inflammatory [12] antibacterial [13] antitumor, antifungal [14], immunostimulant, in the prevention and treatment of cancer [15] and in addition, to the technical applicability as antifouling substances [16]. However, most of these animals consumed still come from extractive fishing. Therefore, it is a challenging task to reconcile the need for conservation with the socioeconomic importance of sea cucumber fisheries. As a result, the fisheries sector has seen the depletion of this resource in traditional fishing areas in Asia and, more recently, the expansion of this activity to new fishing grounds. A global assessment shows that sea cucumber stocks are under intense fishing pressure in many parts of the world and require effective conservation measures [1]. Brazil has a rich biodiversity along its coast. Among the marine species, the sea cucumber has been the target of extraction and informal trade on the coast of São Paulo and in the Northeast region of this country. In the region of Santos Bay, in São Paulo-Brazil, the intense extraction of some species has been routine, followed by informal commercialization, that is, incurring a risk of extinction and public health [17]. The sea cucumber *Holothuria grisea* is one of the species that has been intensively captured, manipulated by extractive activities in the region and sold informally. Information on catches is also scarce. In the state of São Paulo-Brazil, some cases have been reported, with hundreds of kilos of sea cucumbers being seized by the road police. However, its importance in international trade is clear, in view of sea cucumber export and import statistics which, in many cases, are the only information available to measure the magnitude of exploitation. According to Bruckner et al. [18], about 14% of sea cucumber exports came from countries where this fishery is prohibited, such as Panama and Costa Rica, or do not have proper registration, as is the case of Colombia. Other Asian countries are generally deficient in sustainable management practices with a view to sea cucumber conservation. The two main producing countries, Philippines, and Indonesia, lack the specific management measures necessary for the conversion of sea cucumbers. In addition, the lack of accurate statistics, habitat loss, global warming and the excessive and uncontrolled use of these resources signal the threat of extinction. In Brazil, the sea cucumber is one of the focus species of the National Action Plan for the Conservation of Coral Environments (PAN Corais). According to information from the Red Book of Aquatic Invertebrates, its population has been decreasing. Non-regulation of exports has led to depletion and conservation measures are urgent. According to Normative Instruction number 5, of 2004 May 21, the sea cucumber species *Isostichopus badionotus* (Chocolate-drop cucumber) and *Synaptula secreta* are threatened with extinction or overexploitation. This Normative Instruction was amended by the normative instruction number 52/2005 and revoked by ordinance number 445/2014 of the Environment Ministry, which indicates the species *Synaptula secreta* as critically endangered Brazil [19]. Currently, with the growth of the world population, the anthropic effects have increasingly impacted coastal areas, reducing natural

stocks. In this sense, aquaculture can contribute to the preservation of some species, including echinoderms. However, the investments necessary to produce new species and for the development of new products present a preponderant factor: the existence of demand, that is, market potential. The clandestine or informal trade of these echinoderms in Brazil means that we are not clear about the size of this market in the country. Thereby, in view of the benefits associated with the consumption of sea cucumber to human health, evidenced by scientific research, and that sea cucumber drying process, as used for the flour production, maintains their functional properties [20], it was held a market diagnosis for its flour as a food supplement. This market research aimed to assess the interest of Brazilians in the consumption of sea cucumber flour.

## Method

Market prospecting research for sea cucumber flour was carried out using the Survey Monkey tool. The structured questionnaire consisted of ten closed questions, which were answered by 100 people [21].

## Results and Discussion

The public interviewed was heterogeneous: 36% between 15 and 25 years old; 11% between 26 and 35 years old; 12% between 36 and 45 years old, 18% between 46 and 55 years old and 23% of the public over 55 years old. Demonstrating the market potential of sea cucumber as a food supplement for a wide audience in terms of age. About 97% of the respondents claimed to have never consumed sea cucumbers or derivatives, but 91% expressed interest in consuming sea cucumber-based flour. Among the levels of interest: 33% reasonable, 46% interested and 13% very interested; and 67% indicated the preferential acquisition in capsule form. Regarding the cost for 100g of the product: 64% would pay up to 3.89 dollars, 33% between 4.08 and 5.83 dollars and only 3% would pay more than 5.83 dollars. As for the frequency of consumption: 53% would consume daily. Therefore, the research indicated market potential for sea cucumber flour, especially in capsules, as a food supplement.

## Conclusion

The production of these organisms through aquaculture and the processing of sea cucumber flour-a product that is easier to conserve, store, transport and with added value, in terms of nutritional and functional aspects, will meet the prospects of the current market that seeks greater healthiness through nutrition and/or supplementation and foods with a lower carbon emission. Added to this, the scientific literature highlights that global food and nutrition security must be achieved by increasing food production, improving the nutritional quality of food produced and reducing food waste production. The food waste is still a reality in the current market, as well as the situation of food insecurity on the part of the world population. When we talk about fish, the issue of the waste is even more delicate, as losses often start in primary production, especially due to the fragility of this food and the deficiency in post-harvest practices, an issue that can be aggravated by the informality of the activity. Thus, the development of fish products stable at room temperature, such as sea cucumber flour,

added to the training of the human resources involved, could boost the production of these organisms, through integrated multitrophic aquaculture, a more balanced cultivation system which seeks to promote greater environmental sustainability and economic stability through product diversification and risk reduction.

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